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ABSTRACT

The purpose of this paper is to provide a comprehensive, empirical procedure to measure attitude change which is induced by exposure to environmental spot announcements. The paper contains eight sections, a bibliography, and five appendices. Section one deals with the definition of attitudes and environmental attitudes. Section two presents a justification for the use of television spot announcements. Section three explains the two populations who provided experimental samples: (1) seventh- and eighth-grade students and (2) eleventh- and twelfth-grade students. The production of spot announcements and consideration of the use policies of stations are considered in section four. Section five reviews the selection of the evaluation instrument which satisfies six criteria: objectivity, relevancy, validity, sensitivity, comparability, and utility. Section six considers the semantic differential, a combination of associational and scaling procedures for measuring attitudinal shifts. Section seven focuses on the experimental design. A discussion of semantic differential data is included in the last section. (Author/TK)

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AN ANALYSIS TECHNIQUE FOR THE EDUCEMENT OF AFFECTIVE CHANGE IN URBAN SECONDARY STUDENTS AS A CONSEQUENT OF VIEWING ENVIRONMENTAL SPOT ANNOUNCEMENTS

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An Analysis Technique For The Educement Of Affective Change In Urban Secondary Students As A Consequent Of Viewing Environmental Spot Announcements

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INTRODUCTION

Within the last decade, public acceptance of environmental quality as an important national goal has increased at a feverish pace. Unfortunately, these "environmental concerns" have often been subjected to misinterpretation and misuse by persons who posit generalizations about environmental quality which are not based upon sound empirical investigation. What is needed, at this time, is a vehicle which will do two things: (1) Change attitudes influenced by such incorrect information and (2) Provide the various publics in this country with on-going information so that attitude clusters relevant to the development of a dynamic environmental ethic can be achieved.

It is the belief of the author that such environmental attitudes can be developed when these publics are exposed to non-commercial environmental spot announcements. This is possible, since the phenomenon of television pervades the milieus of individuals in this country--96% of all households in the continental U.S. have TV sets (Rahmel, 1971, p. 5).

It is the purpose of this paper to provide a comprehensive, empirical procedure to measure attitude change which is educed by exposure to environmental spot announcements. It is a rigorous procedure which accounts for myriad variables involved in the measurement of attitude change. Additionally, the procedure's robustness deals effectively with the <u>significant</u> problem of using gain scores in the measurement of change.

A DEFINITION OF ATTITUDE AND "ENVIRONMENTAL ATTITUDES"

It is not the intent of this paper to provide a comprehensive examination of extant attitude theory and attitude change perspectives. It is, however, critical to delineate parameters for these concepts.

When one attempts to elucidate a definition of attitude, the result tends to be a forced fit of philosophical metaphors into some quasi-empirical operational definition. This is especially true since an attitude is a complex, not entirely understood, system of mutually interdependent parts. In order to give such a concept form, each investigator has historically devised a definition of attitude whose abstractness can be accommodated for in a particular experimental design. The following example definitions of attitude substantiate this fact:

> "predispositions to respond in a particular way toward a specific class of objects" (Rosenberg, et al., 1960, p. 1)

> "a disposition to react favorably or unfavorably to a class of objects" (Sarnoff, 1960)

It is clear that these definitions lack the precision and measurability necessary for a study such as this one. As a consequent, this study will employ a synthesis of two definitions in an attempt to provide clear conceptual parameters. The first definition will provide a domain, or gestalt view, of attitude:

> "(Attitudes)...are predispositions to respond, but are distinguished from other such states of readiness in that they are predisposed toward an <u>evaluative</u> response." (Osgood et al., 1957, p. 189)

The second definition provides a dissected view of the component parts of an attitude:

> "(An Attitude is)...an enduring system of positive or negative evaluations, emotional feelings, and pro or con action tendencies with respect to a social object" (Krech et al., 1962, p. 177).

One senses from the above views that commonality exists within such definitions. That is, each describes, or alludes to, three component parts of an attitude. It is these three components, cognitive, feeling, and action tendency, which will comprise the operational definition of attitude for this study. All are mutually interdependent. All interact, at times with unequal magnitude, with components of other attitudes. The cognitive component of a particular attitude constitutes the beliefs of an individual about an object. The feeling component provides the "emotional loading" toward the object; and the action tendency component provides the behavioral readiness associated with the particular attitude.

There are to be sure more precise definitions of this affective domain (e.g. Krathwohl, et al., 1964), but the lack of empirical validation for such taxonomies precludes their application to this study. Several additional volumes will provide the reader with a more comprehensive treatment of attitude theory (Cohen, 1964; Kiesler et al., 1969; Greenwald et al., 1968).

For the purpose of this paper, it is important to provide additional qualification for the term "environmental attitudes". In developing appropriate attitudes toward man's social and physical environment, reliance for success has been placed primarily upon our educational system. When viewed as the panacea for such a problem solution, however, one is immediately restricted to

the parameters that, in great part, contributed to our present environmental condition. That is, "Our present educational methods, at all levels, tend to foster a common intellectual skill: thinking the world to pieces." (McInnis, 1972, p. 10). What is needed, then, is to change persons' attitudes of "technological reductionism" to attitudes of "synthesizing parts into wholes" (McInnis. 1972, p. 10). It is this activity which will be called creating "environmental attitudes" in the study. Our educational system, where socialization is presumed to take place, has misshaped extant attitudes toward man's environment. In synthesizing the parts into wholes (i.e. conceptualizing particular sub-systems in a holistic context) appropriate environmental attitudes can be developed.

USE OF TELEVISION SPOT ANNOUNCEMENTS

There are several reasons that television spot announcements were selected as the medium in which to effect environmental attitude change. Perhaps most important is the fact that the presentation of the stimuli (i.e. spot announcements) can be repetitive. As a consequent of increased frequency-of-usage, there will be greater latency of the attitude change effected by the spots. Second, television households (96% of all families in the U.S.) watch an average of 45 hours and 41 minutes of television each week, or 6 1/2 hours each day (Rahmel, 1971, p. 10). Third, the use of television avoids the parameters and problems generated by attempting to achieve the same effect in educational establishments. Fourth, the Federal Communications Commission has mandated that television stations must broadcast public service time in "adequate quantity" (Paluszek, 1971, p. 22). Since cigarette advertising has been withdrawn, availability of public service time has greatly increased. Therefore, it is possible to obtain air time during prime time periods.

SAMPLE POPULATIONS

In this study, two populations of individuals will provide experimental samples: (1) seventh and eighth grade, and (2) eleventh and twelfth grade. Generally speaking, the first group was selected because its members have entered the "formal operational period of development" (Piaget and Inhelder, 1969, p. 149). In this period the child "grasps the possible transformations and assimilates reality...in terms of imagined or deduced events" (Piaget and Inhelder, 1969, p. 149). It is at this stage of development that the child is able to deal with abstract, "ideal", or "supra-individual values". He is capable of forming theories and dealing with: "affective value, social justice, and social ideals" (Piaget and Weil, 1951, pp. 605-621). Additionally, this group is just reaching the point in its moral development where: "Right action tends to be defined in terms of general rights and in terms of standards which have been critically examined and agreed upon by the whole society" (Kohlberg, 1968, p. 29).

The second group was selected because it is preparing to leave public school and effect an impact upon man's environment using its own perceptions and apperceptions as guidelines for behavior. It is important to note that these students will never again be under the control of a mandated educational system. This is critical since socialization, which is the purported function of mandatory education, will henceforth be occurring only by chance events.

The sample population will be comprised of: one hundred twenty seventh grade students, one hundred twenty eighth grade students, one hundred twenty eleventh grade students and one hundred twenty twelfth grade students.

PRODUCTION OF SPOT ANNOUNCEMENTS

It is essential, in the production of spot announcements for specific audiences, that messages and formats be systematically designed. To do this, each alternative message and format combination should be subjected to pre-production testing on the specific audience, or audiences. This can be accomplished through the use of anecdotal records and attitude checklists. In such audience evaluation, perceptions of existing, sample spot announcements are examined in an effort to extract the best alternative format and message combination. Additionally, specific audiences will have an opportunity to subjectively comment on relevance of the measuring instrument for evaluating their perceptions of spot announcements.

Even though an understanding of audience perceptions of spot announcements is necessary before production can begin, it is more critical to consider the use policies of stations which will broadcast each spot announcement. For example, most stations give primary consideration to the content of a public service announcement, rather than to the organization which produced the spot (Paluszek, 1971, p. 22). They also expect a brief background note which describes why the spot is being produced and in what way it serves the public interest. Since such information is not readily available, or consistent, for each station in the country, a tangential study must be conducted which will survey each commercial station in the country to determine their criteria for selection (Appendix A contains that survey).

Parenthetically, this study will employ the "alternative-choice" format in producing spot announcements. It is a scripting method in which a

particular problem is cited (e.g. dune vegetation degradation or estuarian destruction) and alternative choice solutions (e.g. building development zoned for back dunes only or landfill operations prohibited on, or bordering, estuaries) are proposed.

Having selected the scripting format, the spot production process can begin. An assessment of subject and appeal guidelines set forth by the test audience is made. Parameters of acceptability for subjects, appeals and formats for television stations in each region of the country are determined from the station survey (Appendix A). Scripting of the spot announcements takes place. Pre-production re-evaluation of the script is made by the production team, and production of the spot through the interlock stage is completed. Again, the spot announcement is subjected to refinement through viewing of the interlock by representative samples from: the test audience, the broadcast industry, content specialists, and the organization sponsoring the spot announcement. With this refinement phase completed, the spot announcement is sent to the lab for printing of distributable copies.

SELECTING THE EVALUATION INSTRUMENT

In selecting an evaluation instrument for measuring connotative meaning space (i.e. affective meaning), it is necessary to locate an instrument which satisfies these criteria adequately: (a) objectivity, (b) reliability, (c) validity, (d) sensitivity, (e) comparability, and (f) utility (Osgood, 1952, p. 219). The evaluation instrument selected for this study, the semantic differential technique, does adequately satisfy these criteria.

As indicated by Osgood, the semantic differential does produce data which are verifiable by applying the same instrument to equivalent subjects. In collecting the test data for factor analysis work, Osgood discovered a reliability coefficient of .85 (Osgood, 1952, p. 228). He also obtained face validity on extant data.

Attitude measurement techniques have been extremely negligent in measuring the change of fine distinctions of meaning which occur regularly in culture. The semantic differential, by its design, has been able to overcome this problem. For example, it is difficult for Americans to explain the difference in meaning between the words good and nice (Snider and Osgood, 1969, p. 34). Yet using the semantic differential, subjects were able to discriminate between these terms, and therefore, demonstrated the instrument's sensitivity.

When an experiment is concerned with comparability of connotative meaning, as this study is, it is possible to employ semantic differential data to compare: (1) different individuals' affective meaning and (2) the

affective meaning of different concepts. The instrument also affords diverse utility in that it can measure: (1) semantic norms, (2) individual differences in meaning and (3) changes in meaning (Snider and Osgood, 1969, p. 35).

The semantic differential, therefore, satisfies the six criteria listed above. It is significant that no other attitude evaluation instrument is able to meet these criteria as adequately. These other instruments (physiological measures, learning measures, association measures, and scaling methods) have major flaws which render their data irrelevant, or at best, questionable (Osgood, 1952, p. 220).

Having justified the necessity of using the semantic differential to measure affective meaning and affective meaning change, it is important to specify what the semantic differential is.

THE SEMANTIC DIFFERENTIAL[1]

The semantic differential "is a combination of associational and scaling procedures" for measuring attitudinal shifts (Osgood, 1952, p. 220). It "...measures certain affective features of total meaning, closely related to dimensions of emotion or feeling, which appear to be universal in the human species." "Semantic differential technique highlights these affective features at the expense of other semantic features..." (Osgood, 1969, p. 194). To do this, the semantic differential provides a subject with a particular concept which is to be differentiated against a set of bipolar adjective scales. As a result, affective meaning can be quantified in a multi-dimensional "semantic space".

[1]Comprehensive treatment of the semantic differential technique can be found in. (Osgood, Suci, and Tannenbaum, 1957) and (Osgood and Snider, 1969).

THE MEDIATION PROCESS

The theoretical basis for the Semantic Differential centers around the representational mediation process which Osgood posited to describe meaning. (Osgood et al., 1957, pp. 5-9).

In this sign behavior, "Certain stimulus patterns have 'wired-in' connection with certain behavior patterns (unconditional reflexes) and additional stimuli have acquired this capacity (conditional reflexes)" (Osgood et al., 1957, p. 5). More specifically, "any pattern of stimulation which is not the object becomes a sign of that object if it produces in an organism a 'disposition' to make any of the responses previously elicited by that object" (Osgood, 1952, p. 202).

For example, consider the connotative meaning of the word rattlesnake. The stimulus-objects of poisonous fangs, stealthful movement, and the distinctive sound of a rattle educe a complex pattern of behavior. Such behavior is loaded with fear activity, since a threat context has been ascribed to rattlesnake by other human beings. Repetition of the stimulus-object (e.g. mention that there is a rattlesnake nearby) will cause the mediation process to be some replica of the initial mediation process, but will still educe the fear significance of the sign, rattlesnake. Such a mediation reaction will produce a particular set of self-stimulation which can lead to a variety of overt behaviors (e.g. looking for a defensive weapon or fleeing to safety).

The mediation process, then, constitutes some internalized program of responses which educes a variety of overt behaviors. It is this mediation mechanism which is the meaning of a particular sign, since it is developed from

the total overt behavior extant when the sign process is established.

This mechanism is of central importance to the present study since changes in the meaning of signs are dependent upon changes of behavior with respect to objects. The specific intent of the environmental spot announcements will be to cause such changes in the viewing public.

THE LOGIC OF THE SEMANTIC DIFFERENTIAL

Since the basic function of verbal communication is transmission of meaning, it is appropriate to use linguistic encoding as a tool to discriminate meanings of concepts. Osgood, however, cautions that use of this approach as an index of meaning requires "(a) a carefully devised sample of alternative verbal responses which can be standardized across subjects, (b) these alternatives to be elicited from subject rather than emitted so that encoding fluency is eliminated as a variable, and (c) these alternatives to be representative of the major ways in which meaning vary" (Osgood et al., 1957, p. 19). The use of such successive alternatives eliminates the uncertainty that may otherwise result regarding the object being considered. Insertion of continua scales between the common verbal opposites used to measure each concept will increase its sensitivity by indicating valence and direction of a particular "judgement."

The logical base of the semantic differential is derived from the following postulates:

(1) There exists a semantic space which comprises "a region of some unknown dimensionality and [is] Euclidian in character" (Osgood et al., 1957, p. 25).

(2) "Semantic differentiation of a concept, then, becomes a successive approximation of a point in this semantic space by selection from given, scaled alternatives" (Osgood, et al., 1957, p. 26).

(3) "Direction of a point in the semantic space will correspond to what reactions are elicited by the sign (i.e. concept), and distance from the origin will correspond to the intensity of the reactions" (Osgood et al., 1957, p. 27).

Therefore, what is operationally defined as the location of a concept in semantic space is a representation of the mediational mechanism for a particular concept extant in the responding organism. Further, change in a concept's location in semantic space, over time, constitutes a change in the representational mediation process extant in the organism's meaning for that concept (i.e. sign).

CONSTRUCTION OF THE SEMANTIC DIFFERENTIAL INSTRUMENT

Although there is no general semantic differential test (i.e. concepts and scales differ), the forms and procedure for developing the instrument are standard.

The first step in this development process is the selection of concepts to be judged by particular bi-polar adjective pairs. Since concepts serve as a representation of the stimulus which elicits checking as a response, it is critical that concepts selected for inclusion in the instrument (e.g. estuarine degradation) be particularly relevant to and representative of the area of research (e.g. environmental attitudes). Several rules of "thumb" are suggested by Osgood et al. to accomplish this goal:

(1) "The designer must select concepts for which he can expect graphic demonstration of individual differences."

(2) "The designer must select concepts which have a single, unitary meaning for the responding individual."

(3) "The designer must select concepts which are familiar to the responding individual. Esoteric terms will often cause regression toward the center of the bi-polar continuum." (Osgood et al., 1957, pp. 77-78).

After concepts which meet these "thumb" rules are selected, the second step, selecting the bi-polar pairs, takes place.

Selection of the bi-polar pairs that the concepts are judged against is based upon four criteria:

(1) Since factor alignment of individual scales is impossible to achieve at all times, several scales should be selected which load maximally on a particular factor (dimension) and minimally on other factors (dimensions) of semantic space (Osgood et al., 1957, p. 78).

(2) Scales must be selected which have significant relevance to the concepts being judged (Osgood et al., 1957, p. 78).

(3) Scales must be selected which have semantic stability for the concepts and subjects in a particular study (Osgood et al., 1957, p. 79). Because this study is specifically concerned with the connotative meaning ascribed to certain environmental concepts, use of some bi-polar pairs would be precluded. Large-small, for example, could conceivably have denotative meaning for the concept solid waste and connotative meaning for the concept Council On Environmental Quality.

(4) Scales must exhibit linearity and pass through the origin of semantic space (Osgood et al., 1957, p. 79). As Osgood points out, certain polar opposites (e.g. rugged-delicate) may both connote favorable meaning when viewed separately.

When bi-polar scales, for each concept, have been selected using these criteria, the display format of the instrument must be devised. Osgood et al. have employed two graphic-scale methods for semantic differential research. Statistical analysis of both display formats has shown that there is no significant difference between data generated by each form (Osgood et al., 1957, p. 82). In Form I, each concept is listed to the side of each bi-polar

scale. Concepts and scales are then separated, with a maximum number of different concepts and scales separating repetitions (Osgood et al., 1957, p. 81). In Form II, a concept is listed at the top of each page, and scales against which it will be judged are enumerated below it. Form II will be selected for this study, since it is more satisfying to subjects and allows for more consistent concept meaning for each evaluation event (i.e. each bi-polar pair). For administration of the semantic differential, typical instructions were developed by Osgood, Suci, and Tannenbaum (Osgood et al., 1957, pp. 82-84). In the interest of replicability, such a format will be employed in this study (see Appendix B for example).

The raw data generated by administration of the semantic differential consists of a collection of check-marks for each concept as it is judged against the bi-polar scales. Each individual is asked to differentiate a concept against these bi-polar pairs, indicating the direction and valence of such an association on a seven-step scale. Each check-mark is assigned a numerical value (1-7). Analysis of this semantic differential raw data will be discussed below.

EXPERIMENTAL DESIGN

The experimental design for this study will examine attitude change which occurs as a consequent of exposure to particular stimuli (i.e. environmental spot announcements). Appendix C provides a graphic display of the experimental design.

After selection of the four sample populations, each subject will be given a semantic differential pretest. This pretest will provide a measure of subject attitudes prior to exposure to the spot announcements. Upon completion of the pretest, the subjects within each sample population will be divided into two groups. One group will be exposed to simulated television programming in the classroom. Such exposure will consist of: (1) a segment of a television program; (2) a commercial message; (3) a station identification; (4) the test, environmental spot announcement; and (5) resumption of the television program which began the television exposure. This procedure is used to approximate, as correctly as possible, the stimulus event each subject would experience via regular television broadcasting.

As soon as each subject has been exposed to the simulated television broadcast, they will complete a semantic differential posttest. This posttest will measure attitudes extant following subjection to the test, environmental spot announcement. A second semantic differential posttest will be administered to the subjects two weeks after exposure to the spot announcements. This test will be employed in measurement of the latency of attitudes developed as a consequent of viewing the environmental spot announcement.

The second group of subjects within each sample population will have an opportunity to see the test environmental spot announcement during a two week period on local broadcast television. At the end of that two week exposure period, each subject will complete the semantic differential posttest. Following the test, each subject will be given an "exposure test" to determine if they have viewed the test, environmental spot announcement on broadcast television. For analysis of attitude change this group will then be divided into two groups: (1) those subjects who viewed the test, environmental spot announcement on broadcast television, and (2) those who did not view the test, environmental spot announcement. A second semantic differential posttest will be administered to both groups two weeks after the first semantic differential posttest. Its data will be used in the measurement of the latency of attitudes developed as a consequent of viewing the environmental spot announcement.

A crossing and nesting classification, mixed-effects analysis of variance will be used to determine the significance of the difference between data for each of the three groups within each sample population (i.e. simulated spot announcement, broadcast spot announcement, and no exposure to the spot announcement). Pearson's Product-Moment Correlation Coefficient will be employed to measure the latency of attitudes developed as a consequent of viewing the test, environmental spot announcement for each of the three groups.

ANALYSIS OF SEMANTIC DIFFERENTIAL DATA

Raw data generated by subjects who complete the semantic differential tests administered in this study consist of a series of check-marks for each concept evaluated. To facilitate analysis of the raw data, each subject's response set will be transferred to OpScan response sheets. OpScan, a computer optical scanning technique, will provide several advantages to the data analysis procedure: First, in the transfer of responses to OpScan sheets, bi-polar pairs can be reordered such that all positive adjectives can be arranged on the same pole. That is, a data value of 7 will always indicate a positive connotation. Second, OpScan scoring procedures permit production of multiple sets of data cards, and provide sheet printout at the same time. Third, such a data display procedure reduces the possibility of human card punching errors.

FACTOR ANALYSIS OF SEMANTIC DIFFERENTIAL DATA

In the analysis of semantic differential data, a continuing controversy has centered around the factor loadings of specific bi-polar pairs. Many investigators have assumed that the original factor structures, and factor loadings of bi-polar pairs, presented by Osgood et al. (1957, p. 69), were stable. Recent studies (Smith, 1961, Heise, 1969, and Stiggins, 1972), however, refute this contention. Their analysis of semantic differential data indicates that the dimensionality of the semantic space must be reassessed each time the instrument is employed. Therefore, data generated by this study will be subjected to factor analysis before further evaluation takes place. Such analysis is particularly critical to this study since correct evaluation of the "D" statistic (discussed below) is dependent upon the factor loadings of each bi-polar pair.

The computer program utilized for factor analysis of the data is from the SPSS package available at many universities (Nie et al., 1970, pp. 208-244). An example access program, which can be used with the Syracuse University SPSS Program, for this factor analysis is located in Appendix D.

For the purposes of this study the following statistics will be derived from the data: (1) a Correlation Matrix; (2) Communalities, eigenvalues, and proportion of total and common variance; (3) the initial factor matrix; (4) the rotated factor matrix and transformation matrix, which uses principal factoring with iteration; (5) a factor-score coefficient matrix; and (6) a plot of the rotated factors (Nie et al., 1970, pp. 237-38).

Of primary concern at this stage of evaluation is the information from eigenvalues, proportion of total and common variance, and the rotated factor matrix and transformation matrix. It is this information which will indicate factor loadings of the bi-polar adjective pairs and the "strength" of those loadings. The remaining information will be retained for possible use in evaluating nuances of subject behavior later in the study.

Having completed the factor analysis of semantic differential data, consideration can begin for calculation of the "D" Statistic.

THE "D" STATISTIC

Collection of semantic differential data for analysis can be viewed as a rectangular solid whose dimensions represent bi-polar scales, concepts, and subjects. In such a three

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Insert Figure 1 about here

---

dimensional display, there are k scales, m concepts, and n subjects within the semantic space. Each cell within the matrix, then represents "the judgement of a particular concept against a particular scale by a particular subject" (Osgood et al., 1957, p. 86).

The problem presented by use of such a multi-dimensional instrument becomes one of selecting what data to analyze, and how the analysis should proceed. For example, if the investigator is interested in group data, he will often sum and average over the n subjects to produce a k x m matrix of averaged factor scores. But if he is interested in the meaning of a concept for each individual subject within his sample, the investigator will analyze the set of factor scores (for the k scale) in the column which"represents a particular concept."

These traditional semantic differential studies have oriented analysis to comparisons between particular concepts on a scale-by-scale basis (k x m matrix) but have failed to consider the holistic notion of a single index of meaning (Lynch, 1972, p. 1). It is this notion, the interaction of

scale data in some synergy context, which truly represents an individual's meaning space. Avoidance of this type of approach to semantic differential analysis has made previous studies difficult to interpret, and at best, of dubious practical value.

As was mentioned above, the majority of semantic differential studies approach data analysis either by: computing mean scores of scales on a concept, and then comparing the concepts on a scale-by-scale basis; or computing average scores on each of the dimensions for a particular concept, and then comparing the concepts on a dimensional (factor) basis (Lynch, 1972, pp. 2-4). The effect in each case is to provide average data which do not permit consideration of an overall index in meaning. In the second approach, for example, it is not empirically sound to jump from data provided by the dimensions (e.g. evaluative, potency, and activity) to a statement about the overall meaning space within which the dimensions are residents.

To overcome this methodological problem in the present study, the "D" statistic will be employed. Its utilization will permit measurement of the similarity in meaning between the pretest semantic differential and the posttest semantic differential data, for each individual's semantic space, on each concept.

Before using the "D" statistic, it is important to understand the assumptions involved: (1) It is assumed that the intervals both within a single scale and between scales are equal; and (2) It is assumed that the variables (scales or factors) across which the differences are taken are independent (Osgood et al., 1957, p. 93).

With these assumptions in mind, comparisons will be made using the following formula:

$$D_{i1} = \sqrt{d_{i1}^2}$$

where D_{i1} is the linear distance between points in the semantic space representing the pretest, i, and the posttest, 1; and d_{i1} is the algebraic difference between the averaged coordinates of i and 1 on the same dimension (adapted from Osgood et al., 19[illegible], p. 91).

For the purposes of this study, then:

$$D_{i1} = \sqrt{(X_{\bar{E}_i} - X_{\bar{E}_1})^2 + (X_{\bar{P}_i} - X_{\bar{P}_1})^2 + (X_{\bar{A}_i} - X_{\bar{A}_1})^2}$$

where, D_{i1} is the linear distance between points in the semantic space representing the pretest, i, and the posttest, 1; $\bar{E}$ is the averaged scale score for the evaluative factor; $\bar{P}$ is the averaged scale score for the potency factor; and $\bar{A}$ is the averaged scale score for the activity factor.

With "D" statistics calculated for each individual, in each of three treatment groups, on each concept, this study will next consider the significance of differences in data generated by individuals in the three treatment groups.

CROSSING AND NESTING CLASSIFICATION, MIXED-EFFECTS ANALYSIS OF VARIANCE

Having calculated the "D" statistic in this study, it is possible to make some intuitive conclusions about the educement of affective change as a consequent of viewing the environmental spot announcement. But without utilization of statistical inference, it is impossible to do more than speculate about what the data do in fact indicate. The critical question that this study must examine is: What is the significance of the difference between "D" statistics derived from the three treatment groups who saw: (1) the simulated spots, (2) the broadcast spots, and (3) none of the spots? Further, this study examines the sources of such differences.

To investigate these questions, a crossing and nesting classification, mixed-effects analysis of variance will be employed (See Appendix E). The model utilized in this study was developed by the author under careful supervision by Dr. Joseph D. Kasile. By its design, this "higher-way layout, mixed model" (Scheffe, 1959, p. 282) permits observation of the sources of variation which contribute to the differences between "D" statistics. That is, this assumption model provides for variation due to: (1) the school within which an individual resides, (2) the class within which the individual resides, (3) the treatment which the individual is exposed to, (4) the interaction of the school and treatment, (5) the interaction of the class and treatment, (6) the individual, and (7) error variance.

Insert Figure 2 about here

It is important to note that such an analysis of variance is robust enough to account for the utilization of gain scores (i.e. pretest-posttest). The use of gain scores has been extensively challenged as an adequate measure of change. The conclusion reached by many is that gain scores are "generally not an appropriate way to evaluate the relationship between change in one variable as a function of a second variable" (Bohrnstedt, 1969, p. 114). To overcome the problems involved in using gain scores, McGaw and others, have indicated that a higher-way layout, mixed-effects analysis of variance, such as the one used in this study, must be employed.

The analysis of variance model displayed in Appendix E will be used in the present study to examine the significance of differences between: (1) "D" statistics of those individuals who viewed the simulated spot and "D" statistics of those individuals who viewed the broadcast spot, (2) "D" statistics of those individuals who viewed the simulated spot and "D" statistics of those individuals who did not view the spot, and (3) "D" statistics of those individuals who viewed the broadcast spot and "D" statistics of those individuals who did not view the spot (See Appendix C).

Returning to the model in Appendix E, the following procedure will be implemented to conduct the analysis of variance: Sums of Squares will be calculated for each of the variance terms in the model. These values

will then be used to calculate the error mean squares for the variance terms, which, in turn, will be used to calculate an F statistic for each variance term. By comparing calculated F values with tabular F values (Guenther, 1964, pp. 172-175 and Steel and Torrie, 1960, pp. 436-439), it will be possible to determine if the calculated treatment means are members of different "populations" of if they are simply "aberations" of the same "population" (Steel and Torrie, 1960, pp. 103-104, 117). It should be noted that this study accepts the assumption of normality with respect to the populations being examined (Kerlinger, 1964, p. 258). That is, it is assumed that significant violations of the F statistic do not occur.

If F values, for this study, are significant at the .05 or .01 level (Steel and Torrie, 1960, pp. 103-104) then Tukey's method of pair wise comparisons will be employed (Ryan, 1959, pp. 26-47) (Guenther, 1960, pp. 54-57). Using Tukey's method of pair wise comparisons permits testing of differences between any pairs of means after an analysis of variance, which t tests do not, and indicates whether or not the calculated treatment means are significantly different (i.e. treatment groups reside in different populations).

When the analysis of variance and Tukey's Method have been performed, Pearson's Product-Moment Correlation will be employed to analyze attitude latency two weeks after the first semantic differential posttest. (Ahmann and Glock, 1971, pp. 288-291). Comparisons will be made between immediate semantic differential posttest scores and two-week semantic differential posttest scores

(See Appendix C). High correlation between these scores will be interpreted as an indication of attitude latency as a consequent of viewing the environmental spot announcements.

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APPENDIX A

TELEVISION PUBLIC SERVICE ANNOUNCEMENT SURVEY

Name: _____

Position: _____

Station: _____

Date Survey Completed: _____

(1) What specific appeal types are looked for in selecting PSA's used by your station?

A. ___ Hard-sell

B. ___ Low-key

C. ___ Conflict or competition

D. ___ Emotional stimulation

E. ___ Straight informational

F. ___ Other: _____

G. ___ Appeal types prerogative of sponsor

(2) Public Service Announcements are selected for inclusion in your station's programming by: (check most important criterion, or criteria)

A. ___ when campaign is topical.

B. ___ technical quality.

C. ___ credibility of organization submitting PSA.

D. ___ all of the above.

(3) Please check PSA length which would maximize the possibility of a spot announcement being included in your programming:

A.___10 second

B.___20 second

C.___30 second

D.___ 40 second

E.___60 second

F.___Other:_____ second

(4) What PSA format preferences does your station have:

	strongly prefer	will use	won't use
16 mm silent-color & announcer's script			
16 mm sound-color			
35 mm slides & announcer's script			
2" video-color			
Other:_____			
Other:_____			

(5) In regard to environmental PSA's, please check appropriate boxes:

	Have received PSA's from:	Have aired PSA's from:
Environmental Protection Agency		
U.S. Forest Service		
Soil Conservation Service		
U.S. Dept. of Health, Education, and Welfare		
Sierra Club		
National Wildlife Federation		
Audubon Society		
U.S. Dept. of Housing and Urban Development		
Private Industry		
Advertising Council, Inc.		
Keep America Beautiful		
Other: (fill in)_____		
Other:_____		
Other:_____		

(6) What organization supplies you with the most environmental PSA's?

_____

_____

(7) Generally, environmental PSA's are included in your station's programming:

A.___ in specific time slots requested by the source.

B.___ when gaps in programming permit (e.g. no commercial spots, technical problems, low cost time period).

C.___ when compatible with programs they accompany.

(8) Has your station produced its own environmental spot announcements?

A.___Yes

B.___No

(9) Do you evaluate the impact Environmental PSA's have upon your station's image?

A.___Yes

B.___No

(10) If so, how do you measure their impact?

_____

_____

_____

_____

Please Return to:

P. R. Mehne & C. J. Goulard
EDUCOM
303 Illick Hall
SUNY College of Environmental Science and Forestry
Syracuse, New York 13210

APPENDIX B

AMS-G1/B-MOD-1M: ENVIRONMENTAL ATTITUDES
SEMANTIC DIFFERENTIAL

NAME: _____

CLASS OR ORGANIZATION: _____

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DIRECTIONS

The purpose of this study is to measure what certain things mean to you by having you judge them against a series of descriptive scales. On each page of the booklet you will find a different concept to be judged and below it a set of scales. You should rate each of the scales in order.

Here is how you should use these scales:

If you feel that the concept at the top of the page is very closely related to one end of the scale, you should place your check-mark as follows:

fair __X__ : ____ : ____ : ____ : ____ : ____ : ____ unfair

fair ____ : ____ : ____ : OR : ____ : ____ : __X__ unfair

If you feel that the concept is quite closely related to one or the other end of the scale (but not extremely), you should place your check-mark as follows:

strong ____ : __X__ : ____ : ____ : ____ : ____ : ____ weak

strong ____ : ____ : ____ : OR : ____ : __X__ : ____ weak

If the concept seems only slightly related to one side as opposed to the other side (but is not really neutral), then you should check as follows:

active ____ : ____ : __X__ : ____ : ____ : ____ : ____ passive

active ____ : ____ : ____ : OR : __X__ : ____ : ____ passive

If you consider the concept to be neutral on the scale, both sides of the scale equally associated with the concept, or if the scale is completely irrelevant, unrelated to the concept, then you should place your check-mark in the middle space:

safe ____ : ____ : ____ : __X__ : ____ : ____ : ____ dangerous

IMPORTANT: (1) Place your check-mark in the middle of the spaces, not on the boundaries:

This Not This

____ : ____ : ____ : __X__ : ____X ____ : ____

(2) Be sure you check every scale for every concept--do not omit any.

(3) Never put more than one check-mark on a single scale.

Work at fairly high speed through this test. Do not worry or puzzle over individual items. It is your first impressions, the immediate "feelings" about the items, that we want. On the other hand, please do not be careless, because we want your true impressions.

URBAN PLANNING

Soft	_____:_____:_____:_____:_____:_____:_____	Hard
Pleasant	_____:_____:_____:_____:_____:_____:_____	Unpleasant
Good	_____:_____:_____:_____:_____:_____:_____	Bad
Strong	_____:_____:_____:_____:_____:_____:_____	Weak
Unimportant	_____:_____:_____:_____:_____:_____:_____	Important
Ugly	_____:_____:_____:_____:_____:_____:_____	Beautiful
Active	_____:_____:_____:_____:_____:_____:_____	Passive
Stable	_____:_____:_____:_____:_____:_____:_____	Changeable
Complex	_____:_____:_____:_____:_____:_____:_____	Simple
Dirty	_____:_____:_____:_____:_____:_____:_____	Clean

UNPROTECTED BEACHES

Changeable	_____:_____:_____:_____:_____:_____:_____	Stable
Hard	_____:_____:_____:_____:_____:_____:_____	Soft
Good	_____:_____:_____:_____:_____:_____:_____	Bad
Beautiful	_____:_____:_____:_____:_____:_____:_____	Ugly
Complex	_____:_____:_____:_____:_____:_____:_____	Simple
Active	_____:_____:_____:_____:_____:_____:_____	Passive
Unpleasant	_____:_____:_____:_____:_____:_____:_____	Pleasant
Strong	_____:_____:_____:_____:_____:_____:_____	Weak
Important	_____:_____:_____:_____:_____:_____:_____	Unimportant
Clean	_____:_____:_____:_____:_____:_____:_____	Dirty

PLANNED USE OF COASTAL ZONE

Ugly	_____:_____:_____:_____:_____:_____:_____	Beautiful
Passive	_____:_____:_____:_____:_____:_____:_____	Active
Clean	_____:_____:_____:_____:_____:_____:_____	Dirty
Strong	_____:_____:_____:_____:_____:_____:_____	Weak
Unimportant	_____:_____:_____:_____:_____:_____:_____	Important
Pleasant	_____:_____:_____:_____:_____:_____:_____	Unpleasant
Simple	_____:_____:_____:_____:_____:_____:_____	Complex
Changeable	_____:_____:_____:_____:_____:_____:_____	Stable
Hard	_____:_____:_____:_____:_____:_____:_____	Soft
Bad	_____:_____:_____:_____:_____:_____:_____	Good

COMMERCIAL DEVELOPMENT OF BEACHES

Dirty	_____:_____:_____:_____:_____:_____:_____	Clean
Beautiful	_____:_____:_____:_____:_____:_____:_____	Ugly
Stable	_____:_____:_____:_____:_____:_____:_____	Changeable
Passive	_____:_____:_____:_____:_____:_____:_____	Active
Hard	_____:_____:_____:_____:_____:_____:_____	Soft
Pleasant	_____:_____:_____:_____:_____:_____:_____	Unpleasant
Good	_____:_____:_____:_____:_____:_____:_____	Bad
Simple	_____:_____:_____:_____:_____:_____:_____	Complex
Unimportant	_____:_____:_____:_____:_____:_____:_____	Important
Strong	_____:_____:_____:_____:_____:_____:_____	Weak

RECLAIMING WETLANDS FOR BUILDING DEVELOPMENT

Ugly	_____:_____:_____:_____:_____:_____:_____	Beautiful
Active	_____:_____:_____:_____:_____:_____:_____	Passive
Changeable	_____:_____:_____:_____:_____:_____:_____	Stable
Dirty	_____:_____:_____:_____:_____:_____:_____	Clean
Soft	_____:_____:_____:_____:_____:_____:_____	Hard
Bad	_____:_____:_____:_____:_____:_____:_____	Good
Complex	_____:_____:_____:_____:_____:_____:_____	Simple
Unimportant	_____:_____:_____:_____:_____:_____:_____	Important
Pleasant	_____:_____:_____:_____:_____:_____:_____	Unpleasant
Weak	_____:_____:_____:_____:_____:_____:_____	Strong

REGULATED ACCESS TO BEACHES

Stable	_____:_____:_____:_____:_____:_____:_____	Changeable
Bad	_____:_____:_____:_____:_____:_____:_____	Good
Complex	_____:_____:_____:_____:_____:_____:_____	Simple
Active	_____:_____:_____:_____:_____:_____:_____	Passive
Unimportant	_____:_____:_____:_____:_____:_____:_____	Important
Hard	_____:_____:_____:_____:_____:_____:_____	Soft
Weak	_____:_____:_____:_____:_____:_____:_____	Strong
Clean	_____:_____:_____:_____:_____:_____:_____	Dirty
Unpleasant	_____:_____:_____:_____:_____:_____:_____	Pleasant
Soft	_____:_____:_____:_____:_____:_____:_____	Hard

PLANNED MANAGEMENT OF WETLANDS

Bad	_____:_____:_____:_____:_____:_____:_____	Good
Complex	_____:_____:_____:_____:_____:_____:_____	Simple
Active	_____:_____:_____:_____:_____:_____:_____	Passive
Ugly	_____:_____:_____:_____:_____:_____:_____	Beautiful
Weak	_____:_____:_____:_____:_____:_____:_____	Strong
Clean	_____:_____:_____:_____:_____:_____:_____	Dirty
Soft	_____:_____:_____:_____:_____:_____:_____	Hard
Important	_____:_____:_____:_____:_____:_____:_____	Unimportant
Stable	_____:_____:_____:_____:_____:_____:_____	Changeable
Unpleasant	_____:_____:_____:_____:_____:_____:_____	Pleasant

CITY PARKS

Unimportant	_____:_____:_____:_____:_____:_____:_____	Important
Pleasant	_____:_____:_____:_____:_____:_____:_____	Unpleasant
Soft	_____:_____:_____:_____:_____:_____:_____	Hard
Bad	_____:_____:_____:_____:_____:_____:_____	Good
Ugly	_____:_____:_____:_____:_____:_____:_____	Beautiful
Complex	_____:_____:_____:_____:_____:_____:_____	Simple
Weak	_____:_____:_____:_____:_____:_____:_____	Strong
Changeable	_____:_____:_____:_____:_____:_____:_____	Stable
Clean	_____:_____:_____:_____:_____:_____:_____	Dirty
Passive	_____:_____:_____:_____:_____:_____:_____	Active

EXISTING CITIES

Soft	_____:_____:_____:_____:_____:_____:_____	Hard
Good	_____:_____:_____:_____:_____:_____:_____	Bad
Beautiful	_____:_____:_____:_____:_____:_____:_____	Ugly
Passive	_____:_____:_____:_____:_____:_____:_____	Active
Complex	_____:_____:_____:_____:_____:_____:_____	Simple
Stable	_____:_____:_____:_____:_____:_____:_____	Changeable
Important	_____:_____:_____:_____:_____:_____:_____	Unimportant
Dirty	_____:_____:_____:_____:_____:_____:_____	Clean
Weak	_____:_____:_____:_____:_____:_____:_____	Strong
Unpleasant	_____:_____:_____:_____:_____:_____:_____	Pleasant

WETLANDS

Complex	_____:_____:_____:_____:_____:_____:_____	Simple
Bad	_____:_____:_____:_____:_____:_____:_____	Good
Pleasant	_____:_____:_____:_____:_____:_____:_____	Unpleasant
Stable	_____:_____:_____:_____:_____:_____:_____	Changeable
Active	_____:_____:_____:_____:_____:_____:_____	Passive
Weak	_____:_____:_____:_____:_____:_____:_____	Strong
Dirty	_____:_____:_____:_____:_____:_____:_____	Clean
Hard	_____:_____:_____:_____:_____:_____:_____	Soft
Beautiful	_____:_____:_____:_____:_____:_____:_____	Ugly
Unimportant	_____:_____:_____:_____:_____:_____:_____	Important

DUNE VEGETATION

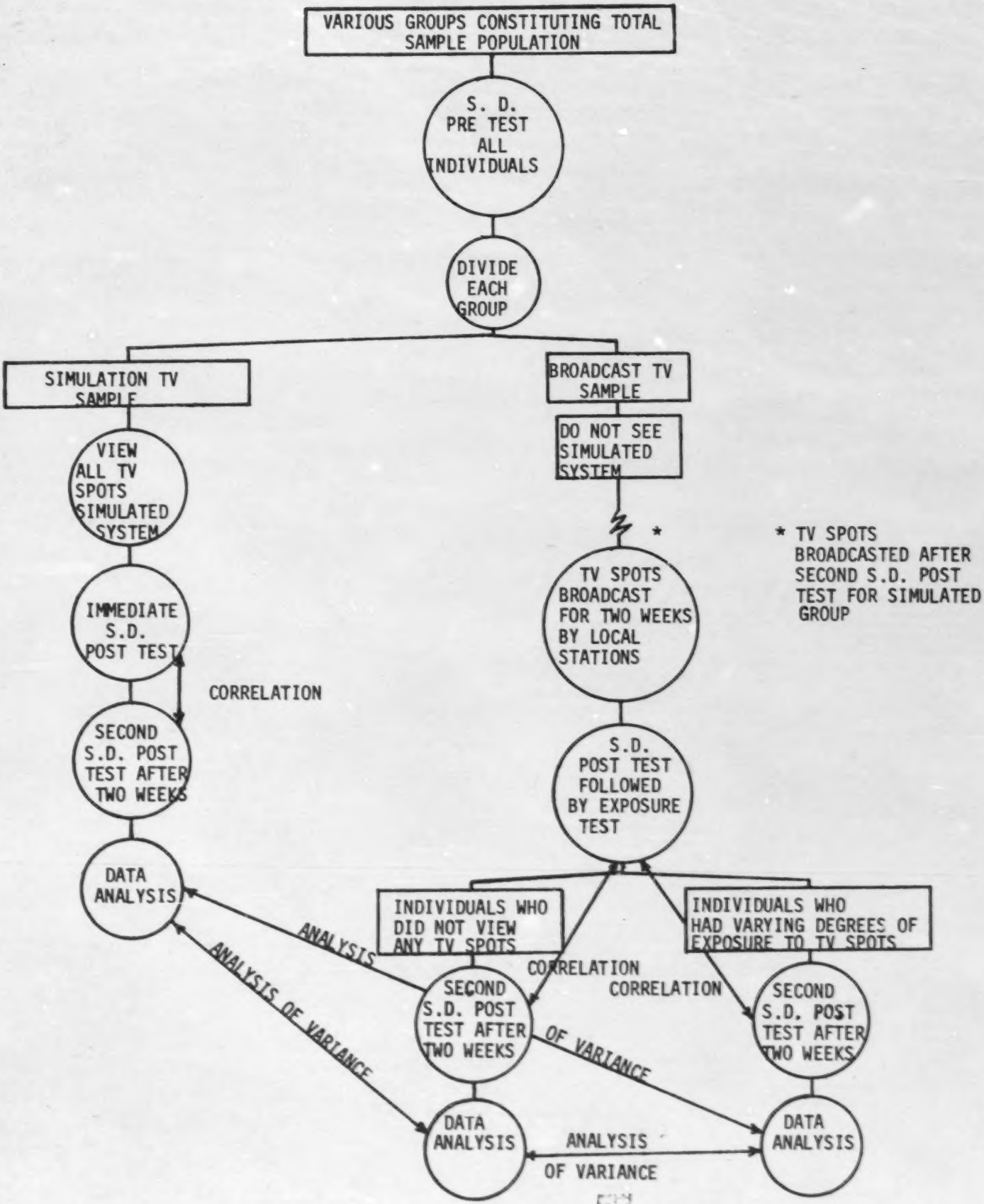
Good	_____:_____:_____:_____:_____:_____:_____	Bad
Weak	_____:_____:_____:_____:_____:_____:_____	Strong
Hard	_____:_____:_____:_____:_____:_____:_____	Soft
Unpleasant	_____:_____:_____:_____:_____:_____:_____	Pleasant
Important	_____:_____:_____:_____:_____:_____:_____	Unimportant
Simple	_____:_____:_____:_____:_____:_____:_____	Complex
Active	_____:_____:_____:_____:_____:_____:_____	Passive
Clean	_____:_____:_____:_____:_____:_____:_____	Dirty
Ugly	_____:_____:_____:_____:_____:_____:_____	Beautiful
Stable	_____:_____:_____:_____:_____:_____:_____	Changeable

FUTURE CITIES

Passive	_____:_____:_____:_____:_____:_____:_____	Active
Unimportant	_____:_____:_____:_____:_____:_____:_____	Important
Soft	_____:_____:_____:_____:_____:_____:_____	Hard
Bad	_____:_____:_____:_____:_____:_____:_____	Good
Beautiful	_____:_____:_____:_____:_____:_____:_____	Ugly
Simple	_____:_____:_____:_____:_____:_____:_____	Complex
Weak	_____:_____:_____:_____:_____:_____:_____	Strong
Pleasant	_____:_____:_____:_____:_____:_____:_____	Unpleasant
Dirty	_____:_____:_____:_____:_____:_____:_____	Clean
Changeable	_____:_____:_____:_____:_____:_____:_____	Stable

APPENDIX C

EXPERIMENTAL DESIGN


VARIOUS GROUPS CONSTITUTING TOTAL SAMPLE POPULATION
S. D. PRE TEST ALL INDIVIDUALS
DIVIDE EACH GROUP
SIMULATION TV SAMPLE
BROADCAST TV SAMPLE
VIEW ALL TV SPOTS SIMULATED SYSTEM
DO NOT SEE SIMULATED SYSTEM
*
* TV SPOTS BROADCASTED AFTER SECOND S.D. POST TEST FOR SIMULATED GROUP
IMMEDIATE S.D. POST TEST
TV SPOTS BROADCAST FOR TWO WEEKS BY LOCAL STATIONS
CORRELATION
SECOND S.D. POST TEST AFTER TWO WEEKS
S.D. POST TEST FOLLOWED BY EXPOSURE TEST
DATA ANALYSIS
INDIVIDUALS WHO DID NOT VIEW ANY TV SPOTS
INDIVIDUALS WHO HAD VARYING DEGREES OF EXPOSURE TO TV SPOTS
ANALYSIS
CORRELATION
CORRELATION
SECOND S.D. POST TEST AFTER TWO WEEKS
ANALYSIS OF VARIANCE
OF VARIANCE
SECOND S.D. POST TEST AFTER TWO WEEKS
DATA ANALYSIS
ANALYSIS
OF VARIANCE
DATA ANALYSIS

APPENDIX D

AN EXAMPLE ACCESS PROGRAM FOR SPSS FACTOR ANALYSIS

```
//          (9991,BMOD,2),'MEHNE',REGION=140K
// EXEC SPSS
//GO.SYSIN DD *
RUN NAME        FACTOR ANALYSIS USING DATA PUNCHED ON CARDS
FILE NAME       PSA BEHAVIOR MODIFICATION
# OF CASES      480
VARIABLE LIST   GROUPNO, GOBAD, BEAUG, ACPAS, CLNDI, STRWK/
INPUT FORMAT    FIXED(28X,17F1.0,F1.0,2X,10F1.0,4X,18F1.0)
INPUT MEDIUM    CARD
PRINT FORMAT    GOBAD TO STRWK (5)
FACTOR          VARIABLES = GOBAD TO STRWK/
                TYPE = PA2/ ITERATE = 50/
STATISTICS      2,4,5,6,7,8
READ INPUT DATA
FINISH
/*
//
```

Note: This program is displayed to indicate the ease with which SPSS Factor Analysis may be accessed. Keep in mind that Job Control Language may vary for different computer facilities.

APPENDIX E

CROSSING AND NESTING CLASSIFICATION, MIXED-EFFECTS ANALYSIS OF VARIANCE

Source of Variation	Degrees of Freedom	Treatment Sum Of Squares	Error Mean Square	F
School	$I-1$	$\left(\frac{1}{JKLM}\sum X^2_{i\ldots\ldots}\right)-CT$	$\sigma^2+M\sigma^2_p+JKLM\sigma^2_S$	$\frac{MS(S)}{MS(P)}$
Group	$I(J-1)$	$\left(\frac{1}{KLM}\sum_{ij}{}^2_{\ldots}\right)-\left(\frac{1}{JKLM}\sum X^2_{i\ldots\ldots}\right)$	$\sigma^2+M\sigma^2_p+KLM\sigma^2_G$	$\frac{MS(G)}{MS(P)}$
Treatment	$(K-1)$	$\left(\frac{1}{IJKLM}\sum X^2_{\ldots k\ldots}\right)-CT$	$\sigma^2+M\sigma^2_p+IJLM\sigma^2_T$	$\frac{MS(T)}{MS(P)}$
School-Treatment Interaction	$(I-1)(K-1)$	$\left(\frac{1}{JLM}\sum X^2_{i\cdot k\ldots}\right)-\left(\frac{1}{IJLM}\sum X^2_{\cdot k\ldots}\right)-\left(\frac{1}{JKLM}\sum X^2_{i\ldots\ldots}\right)+CT$	$\sigma^2+M\sigma^2_p+JLM\sigma^2_{ST}$	$\frac{MS(ST)}{MS(P)}$
Group Treatment Interaction	$I(J-1)(K-1)$	$\left(\frac{1}{LM}\sum X^2_{ijk\ldots}\right)-\left(\frac{1}{KLM}\sum X^2_{ij\ldots}\right)-\left(\frac{1}{JLM}\sum X^2_{i\cdot k\ldots}\right)+\left(\frac{1}{JKLM}\sum X^2_{i\ldots\ldots}\right)$	$\sigma^2+M\sigma^2_p+LM\sigma^2_{GT}$	$\frac{MS(GT)}{MS(P)}$
Individual	$IJK(L-1)$	$\left(\frac{1}{M}\sum X^2_{ijkl\cdot}\right)-\left(\frac{1}{LM}\sum X^2_{ijk\ldots}\right)$	$\sigma^2+M\sigma^2_p$	$\frac{MS(P)}{MS(E)}$
Error	$IJKL(M-1)$	$\left(\sum X^2_{ijklm}\right)-\left(\frac{1}{M}\sum X^2_{ijkl\cdot}\right)$	σ^2	
Total	$IJKLM-1$	$\left(\sum X^2_{ijklm}\right)-CT$		

$$CT=\frac{(\text{Grand Total SS})^2}{(\text{Total No. of Observations})}$$

where, $\sigma^2_S = \frac{\sum \alpha_i^{S^2}}{I - 1}$, $\sigma^2_{GT} = \frac{\sum \alpha_{jk}^{GT^2}}{I\,(J-1)(K-1)}$, etc.

and the x's are totals over the missing subscripts.

Note: Larger numbers of individuals (L) are needed for sufficient power. Additionally, two observations for each individual are needed to test differences of individuals.

FIGURE LEGENDS

FIGURE 1 Matrix For Evaluating Semantic Differential Data

FIGURE 2 Assumption Model For Crossing And Nesting Classification, Mixed-Effects Analysis of Variance

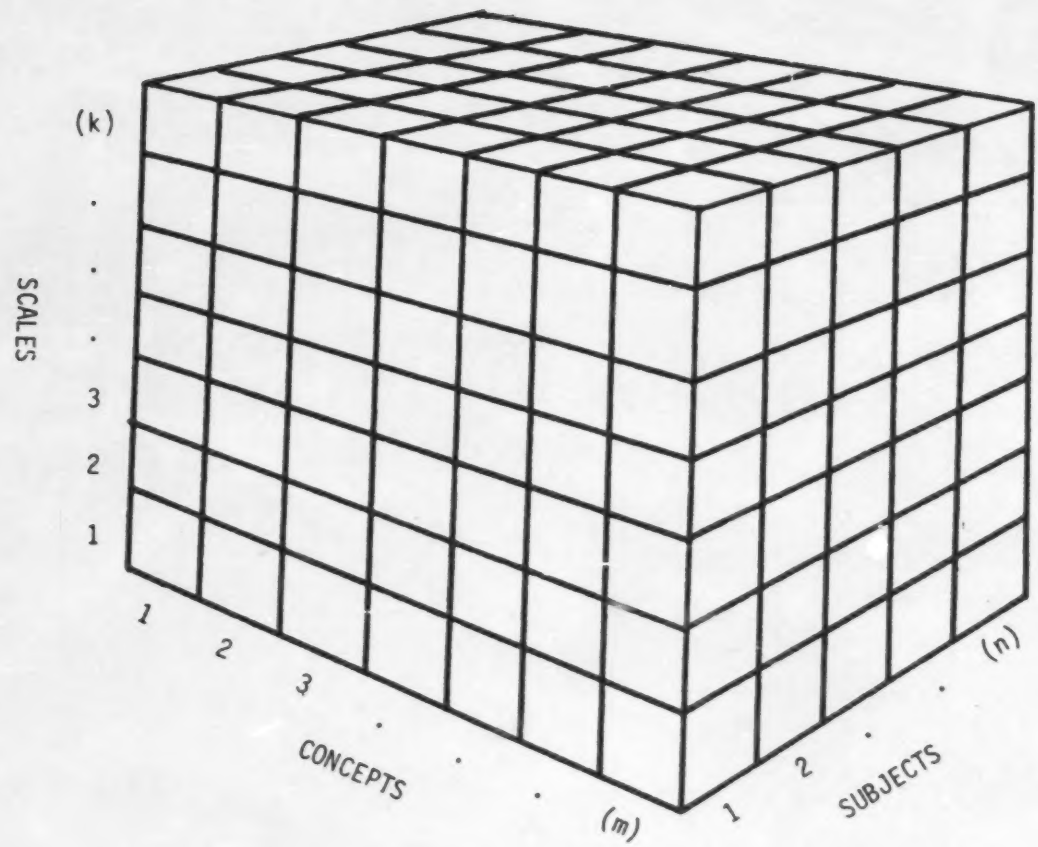


FIGURE 1

$$Y_{ijklm} = \mu + \alpha^{S}_{i} + \alpha^{G}_{ij} + \alpha^{T}_{k} + \alpha^{ST}_{ik} + \alpha^{GT}_{ijk} + a^{P}_{ijkl} + \varepsilon_{ijklm}$$

where,

Y_{ijklm} = D Statistic of a concept for an individual

μ = mean of group treatment for a concept

α^{S}_{i} = variance due to school

α^{G}_{ij} = variance due to group

α^{T}_{k} = variance due to treatment

α^{ST}_{ik} = variance due to interaction of school and treatment

α^{GT}_{ijk} = variance due to interaction of group and treatment

a^{P}_{ijkl} = variance of i^{th} individual from the ijk group

ε_{ijklm} = unaccounted for variance of the D Statistic

where,

α = fixed effect factor

a = random effect factor

ε = error factor

FIGURE 2